At a Glance

- The majority of Canadians are physically inactive and sedentary.
- Strategies or interventions to reduce physical inactivity and sedentary behaviour are required and must be cost-effective, scalable, and sustainable.
- Understanding the determinants of behaviour can help identify effective interventions, including programs and policies, to support and/or increase the opportunity, capability, and motivation to be physically active.
- Examples of effective strategies include teaching individuals how to make plans to act upon their intentions to be physically active and to avoid sedentary behaviour; tracking of behaviour or self-monitoring; and activity-friendly policies and environmental supports for communities and organizations, such as dedicated bike lanes.
Executive Summary

Although most Canadians have the capacity to be physically active—engaging in at least 150 minutes of moderate to vigorous physical activity a week—the majority are inactive and spend most of their day sitting or otherwise being sedentary. This is due to a mismatch between the current environment in which most people live and the physiological and behavioural adaptations that humankind has experienced over a period of 50,000 years.

Therefore, interventions to reduce physical inactivity and sedentary behaviour will not be effective over the long term, or at a population level, if individuals are expected to make rational choices on a regular basis about their behaviour in environments that do not support those choices. Instead, people need to have opportunity (such as a supportive environment), capability, and motivation to avoid or minimize sedentary behaviour. This briefing outlines the criteria that decision-makers can use when planning strategies and programs to promote physical activity and deter excessive sedentary behaviour.

The criteria for an effective intervention (e.g., program, policy) are that it must have demonstrated some impact during rigorous research trials and that there must be clear direction about how it can be adopted, adapted, and implemented by practitioners in different settings for various populations. To address physical inactivity and sedentary behaviour on a large scale (e.g., scaling up), such interventions will need to be practical and cost-effective; have wide appeal for delivery agencies, including public health agencies, workplaces, schools, and health care institutions; and be consistent with strategic targets or objectives of governments and other decision-makers.
Based on a review of the literature, the most effective and scalable interventions to reduce physical inactivity involve teaching individuals self-regulatory strategies (such as planning and self-monitoring), exposing them to positive physical activity experiences, and creating activity-friendly environments through smart and supportive policies.

**Getting From Here to There**

Only 15 per cent of the adult population meets the Canadian Physical Activity Guideline of at least 150 minutes of moderate to vigorous physical activity (MVPA) per week, and the majority of Canadians lead a predominately sedentary lifestyle.¹ These behaviours have been linked to many negative health outcomes in individuals, including the development and worsening of chronic diseases, reduced quality of life, and premature mortality.² Simply put, humans were built to engage in regular physical activity. (See “The Evolution of Human Movement.”)

Physical inactivity and sedentary behaviour can have significant cost implications for the health care system, employers, and the economy. The first briefing of the series “Moving Ahead: Healthy Active Living in Canada,” led by The Conference Board of Canada’s Canadian Alliance for Sustainable Health Care (CASHC), estimated that if just 10 per cent of Canadians who are currently at suboptimal levels of physical activity and sedentary behaviour move more and sit less, it could result in cost-savings to the health care system of $2.6 billion by 2040 and a $1.6-billion boost to the Canadian gross domestic product (GDP).³

This second briefing of the series outlines the criteria that decision-makers—including employers, governments, health authorities, city planners, school officials, and health service providers—can use when planning strategies and programs to promote physical activity and deter excessive sedentary behaviour at different population levels

1 Colley and others, “Physical Activity of Canadian Adults.”
2 Dinh, Moving Ahead: Making the Case for Healthy Active Living in Canada.
3 Bounajm, Dinh, and Thériault, Moving Ahead: The Economic Impact of Reducing Physical Inactivity and Sedentary Behaviour.
and in various settings. These criteria are based on an understanding of the important determinants of these behaviours and will be used in subsequent briefings to identify interventions, including strategies, programs, and policies, that have the greatest potential to reduce physical inactivity and sedentary behaviour. The Conference Board’s “Moving Ahead” research series will eventually address other healthy active living factors, including sleep, nutrition, smoking, and alcohol consumption, and will culminate in final recommendations for all Canadians to move forward on the healthy active living agenda.

The Evolution of Human Movement

Humans are not the strongest or most agile creatures. In fact, we would rank fairly low in the animal Olympics. Our ape cousins would leave us behind in the sprints, twist us into pretzels in any wrestling match, and swing circles around us in the gymnastics competition. But if the events involved walking or running long distances, we would be on the podium. The human body has evolved to be an efficient walking and distance running machine. Perhaps the earliest example of this was when our primitive ancestors went from walking around on their knuckles to attempting to stand up and search for food. Anatomical and physiological adaptations such as longer legs with thicker bones, shorter toes, and more sweat glands enabled humans to walk and/or run much farther than other apes and most other animals.4 The ability to run long distances facilitated hunting and gathering and allowed our early ancestors to acquire high-quality food through scavenging for recent kills or chasing down animals.5 Thus, aside from any impairment, there is no physical reason why modern humans cannot engage in regular physical activity.

However, the patterns of physical activity and sedentary behaviour in developed countries6 have changed substantially over the past 250 years. At the height of the industrial revolution, the majority of energy expenditure for the average

5 Heinrich, Why We Run.
6 Countries with highly developed economies in which wealth is derived more from the service sector than the industrial sector.
citizen was through work, transport, household activities including child care, and food procurement. Leisure activities were only for the wealthiest segment of the population. With further technological innovations and the advent of motorized transport in the 1900s, sitting and leisure-time physical activities became more frequent across the population. For instance, between 1950 and 2000, the proportion of people working in occupations that entailed little physical activity increased by 83 per cent in the United States, while the number of miles travelled per person increased by 224 per cent and trips to work by walking decreased by 71 per cent.\footnote{Brownson and others, “Declining Rates of Physical Activity in the United States.”} Canadian adults spend approximately 10 hours per day, or 69 per cent of waking time, sitting.\footnote{Colley and others, “Physical Activity of Canadian Adults.”} Thus, the majority of adults in developed countries do not engage in sufficient levels of physical activity.\footnote{World Health Organization, \textit{Global Status Report on Noncommunicable Diseases 2010}.}

\section*{Distinguishing Between Physical Inactivity and Sedentary Behaviour}

As previously mentioned, an understanding of physical inactivity and sedentary behaviour and their determinants is important in identifying which interventions have the greatest potential to address these behaviours. Indeed, differences do exist between physical activity and sedentary behaviour and the contexts or settings in which they occur. Physical activity is “any bodily movement produced by skeletal muscles that requires energy expenditure above the basal level.”\footnote{U.S. Department of Health and Human Services, \textit{Physical Activity and Health}.} Physical activities can range in intensity from light to vigorous and can be categorized as leisure, occupation, household, or transport. For example, exercise, which is defined as planned, structured physical activity at a moderate to vigorous intensity, is a source of moderate or vigorous physical activity that usually occurs during leisure time. The

\begin{thebibliography}{9}
\bibitem{7} Brownson and others, “Declining Rates of Physical Activity in the United States.”
\bibitem{8} Colley and others, “Physical Activity of Canadian Adults.”
\bibitem{9} World Health Organization, \textit{Global Status Report on Noncommunicable Diseases 2010}.
\bibitem{10} U.S. Department of Health and Human Services, \textit{Physical Activity and Health}.
\end{thebibliography}
primer document in the “Moving Ahead” research series\textsuperscript{11} summarizes the various age-related Canadian physical activity guidelines. Physical inactivity is often defined as not meeting physical activity guidelines.\textsuperscript{12}

Metabolic equivalent of task (MET) is a unit of measure for energy expenditure that is defined as “the resting metabolic rate.” It is the amount of oxygen consumed at rest, sitting quietly in a chair, which is approximately 3.5 millilitres of oxygen per kilogram per minute (1.2 kilocalories per minute for a 70-kilogram person).\textsuperscript{13} Sedentary behaviour is “any waking behaviour characterized by an energy expenditure less than or equal to 1.5 METs while in a sitting or reclining position.”\textsuperscript{14} Consequently, sedentary behaviour relates to body posture, such as sitting or reclining, in addition to low energy expenditure and physical inactivity. Therefore, unlike physical inactivity, the solution to sedentary behaviour for an able-bodied\textsuperscript{15} person can be as simple as standing up. Similar to physical activity, sedentary behaviour can be classified as occurring in leisure, occupational, household, and transportation contexts. Current guidelines for sedentary behaviour in Canada cover children and youth only. For a summary of the guidelines refer to the primer document.\textsuperscript{16} Unfortunately, sedentary behaviour guidelines currently do not exist for adults; however, it is generally recommended that adults avoid long periods of sitting throughout the day. A comparison of the various guidelines reveals that it is possible to be physically active and sedentary on a daily basis, otherwise known as “an active couch potato.”

\begin{enumerate}[11]
    \item Dinh, \textit{Moving Ahead: Making the Case for Healthy Active Living in Canada}; See also \url{www.csep.ca/english/view.asp?x=804}.
    \item Sedentary Behaviour Research Network, “Letter to the Editor.”
    \item Jetté, Sidney, and Blümchen, “Metabolic Equivalents (METs),” 555–65.
    \item Ibid. See Dinh for a further explanation of METs.
    \item Living without injury, disease, or impairment that limits physical mobility.
    \item Dinh, \textit{Moving Ahead: Making the Case for Healthy Active Living in Canada}. See also \url{www.csep.ca/english/view.asp?x=804}.
\end{enumerate}
The usual types of physical activities and sedentary behaviours vary by age or life stage. Much of the activity of young children is in active or free play, whereas older children ages 6 to 11 years participate in physical education (PE) and sports and have the opportunity to engage in more active transport, for example walking to school. As children transition to adolescence and reach puberty, a significant decline in energy expenditure usually occurs\textsuperscript{17} and almost all of the moderate or vigorous activities occur in an organized setting such as sports or physical education. In adulthood, when exercise replaces play and sports, watching television accounts for more than half of leisure activity.\textsuperscript{18} For older adults, work and child care responsibilities often diminish or disappear and leisure-time activities become a main source of physical activity. The determinants of physical activity and sedentary behaviour clearly vary across life stages. For instance, young children have less independence to move around a neighbourhood on their own, so parents are an important influence on their behaviour. Similarly, adults may not have much choice about the amount of time they are sedentary due to the design of their workplace, such as hours sitting at a desk in front of a computer.

The balance between physical activity and sedentary behaviour has shifted over the last century and is now starting to accelerate toward more sedentary living. In the U.S., total physical activity in energy expenditure is decreasing at a rate of approximately 1 per cent per year. This includes a decrease of 1.2 per cent for occupational physical activity, a decrease of 0.8 per cent for domestic physical activity, a decrease of 0.5 per cent for active travel, and an increase of 2.6 per cent for active leisure. The number of hours spent in a sedentary state per week is also increasing at a rate of 1.3 per cent annually.\textsuperscript{19} It is reasonable to assume that similar patterns and trends would be observed in Canada. As noted in the previous briefing, sedentary

\textsuperscript{17} Rowland, “The Biological Basis of Physical Activity.”
\textsuperscript{19} Ng and Popkin, "Time Use and Physical Ability."
behaviour has the most impact on the risk of mortality among Canadians; an emphasis should be placed on getting people to move more throughout the day. To this end, strategies including programs, policies, and other actions should target these behaviours in workplaces, schools, homes, communities, and the health care system, as well as promote more active transportation. To determine which interventions hold the most promise and potential, it is necessary to identify the key factors or determinants of physical inactivity and sedentary behaviour, including motivation, capability, and opportunity.

What Motivates Behaviour? Theories and Models of Behaviour Change

Reviews of the literature identify many factors or correlates that are associated with physical activity, including age, sex, education, income, ethnicity, body weight, climate, smoking status, health status, attitudes, perceived control, self-efficacy, intentions, motivation, commitment, perceived barriers, knowledge, skills, distance from a fitness facility, aesthetics, having home exercise equipment, amount of park space, time spent outdoors, spousal support, number of children at home, extraversion, neuroticism, exercise intensity, exercise type, cohesion, group norms, class size, muscle fibre type, and genetic predisposition.

Similar reviews are now appearing for sedentary behaviour. For example, age, education, employment status, body mass index, having children in the home, attitudes, and life satisfaction correlate with different sedentary behaviours among adults and similar reviews have been conducted among youth. To date, the two categories of physical activity correlates that have received the most attention are the intrapersonal/psychological

20 Bounajm, Dinah, and Thérioault, Moving Ahead: The Economic Impact of Reducing Physical Inactivity and Sedentary Behaviour.
21 Dishman, “Determinants of Participation”; Trost and others, “Correlates of Adult’s Participation.”
22 Rhodes, Temmel, and Mark, “Correlates of Adult Sedentary Behaviour.”
23 Tremblay and others, “Systematic Review of Sedentary”; Salmon and others, “Health Risks, Correlates, and Interventions.”
or “cognitive” category and the interpersonal or “social” category. Models that combine these two categories have been labelled “social cognitive” models, such as the social cognitive theory, theory of planned behaviour, and transtheoretical model.

Theoretical models serve as important organizing frameworks for understanding and intervening upon physical activity and sedentary behaviour by helping researchers and practitioners identify the factors that influence behaviour. Unfortunately, because sedentary behaviour has only recently become a focus of research, limited work is available to assess the usefulness of such models in that area. Social cognitive models dominate the physical activity literature at present, and beliefs about capability (e.g., self-efficacy, perceived control) and experiences such as enjoyment and pleasure are reliable correlates of intention to be physically active and being physically active. However, there are fewer results for intervention research. Beliefs about health benefits and risk have not been reliably associated with physical activity. Based on research showing a large intention-behaviour gap, where at least half of individuals who intend to engage in physical activity do not follow through, recent models have split intention and behaviour into two phases. Beliefs generally affect intention to act, but the translation of intention into behaviour is a result of strategies such as planning (such as making “if-then” plans) and self-monitoring (for example, tracking the number of steps taken in a day).

The role of the environment as an enabler of choice is emphasized in theories such as behavioural choice theory and ecological models. The underlying principle in behavioural choice theory, or behavioural

24 A model in this context refers to a way of thinking about a concept; it often includes relationships between ideas/elements/factors/outcomes; it is a way of thought and is often used to explain a theory or mechanism.
25 Higgins and others, “Physical Activity Interventions”; Lubans, Foster, and Biddle, “A Review of Mediators of Behavior.”
26 Rhodes and de Bruijn, “How Big Is the Physical Activity Intention-Behaviour Gap?”
27 Rachlin, Judgement, Decision, and Choice.
28 Spence and Lee, “Toward a Comprehensive Model of Physical Activity.”
economic theory (or “nudging”),\textsuperscript{29} is that people make choices in terms of the costs associated with the potential options provided by the environment. Choices among the alternatives are based on individual preferences and attractiveness of choice; availability and accessibility of various choices; the reinforcing value, either positive or negative, of each choice; the behavioural costs of obtaining the choice; and the extent to which the individual likes the given choice.\textsuperscript{30} Thus, increasing access to options for physical activity, and reinforcing the value of the behaviour, while increasing the costs of sedentary behaviours is a suggested approach. Examples of this include requiring children to do chores in exchange for credits for TV or computer time and taxing devices that promote sedentary behaviour, such as computer games. Ecological models place even more emphasis on how the environment influences physical activity and sedentary behaviour.\textsuperscript{31} Though there is a role for motivation and capability, the distinguishing factor between ecological models and the social cognitive models is that an environment that creates opportunity can have a direct influence on behaviour.\textsuperscript{32}

Finally, dual process theory represents an approach to understanding physical inactivity and sedentary behaviour that includes both the beliefs and experiences seen in social cognitive theories or attitudes and more automatic unconscious processes, also known as habits.\textsuperscript{33} The idea is that behaviour is influenced by both conscious and unconscious processes. However, because the automatic processes operate much more quickly, and at an unconscious level, than the conscious ones, they have more influence on behaviour than people are aware. For example, sitting at a desk in the workplace or when entering a room may be directed more by habit than higher-level thinking. This approach has seen early support in physical activity\textsuperscript{34} and may represent an important

\textsuperscript{29} Epstein, “Integrating Theoretical Approaches.”
\textsuperscript{30} Ibid.
\textsuperscript{31} Owen and others, “Adults’ Sedentary Behavior.”
\textsuperscript{32} Spence and Lee, “Toward a Comprehensive Model.”
\textsuperscript{33} Evans and Stanovich, “Dual-Process Theories of Higher Cognition.”
\textsuperscript{34} Gardner, de Bruijn, and Lally, “A Systematic Review and Meta-analysis.”
link with environmental cues and prolonged sedentary behaviour. Behavioural choice/economic theory, ecological models, and dual-process theory are the underpinnings of choice architecture and the concept of “nudge.”

**An Interventions Framework**

The behaviour change wheel is a commonly used framework for characterizing behaviour change interventions. It is based on a systematic review of 19 existing frameworks or classifications of interventions and has undergone several tests of reliability for use in both research and practice. At the framework’s core is the notion that behaviour is influenced by many factors, including a combination of capability (both physical and psychological), opportunity (both physical and social), and motivation (both conscious and automatic). Together, these factors encompass many of the elements associated with behaviour change theories and models. The next layer in the framework consists of nine types of interventions, including education, persuasion, incentivization, coercion, training, restriction, environmental restructuring, modelling, and enablement. (See Table 1.) Since policies can “only influence behaviour through the interventions that they enable or support,” they are located on the outer layer of the wheel. Policies can be characterized as communication/marketing, guidelines, fiscal, regulation, legislation, environmental/social planning, as well as service provision.

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35 Thaler and Sunstein, *Nudge*.
36 Michie, van Stralen, and West, “The Behaviour Change Wheel.”
37 Ibid., 6.
The framework shows how and what interventions influence behaviour through all the influential factors and the supportive or non-supportive role of policies. (See Table 1.) Ultimately, according to Michie, van Stralen, and West, one should be asking “What conditions internal to individuals and in their social and physical environment need to be in place for a specified behavioural target to be achieved?”

Ibid., 9.
<table>
<thead>
<tr>
<th>Intervention</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>Increasing knowledge or understanding</td>
<td>Providing information about negative effects of sedentary behaviour</td>
</tr>
<tr>
<td>Persuasion</td>
<td>Using communication to induce positive or negative feelings or stimulate action</td>
<td>Using imagery to motivate increases in physical activity</td>
</tr>
<tr>
<td>Incentivization</td>
<td>Creating expectation of reward</td>
<td>Using prizes to encourage participation in sports</td>
</tr>
<tr>
<td>Coercion</td>
<td>Creating expectation of punishment or cost</td>
<td>Raising the financial cost of consuming TV or video games</td>
</tr>
<tr>
<td>Training</td>
<td>Imparting skills</td>
<td>Emphasis on physical literacy for young children</td>
</tr>
<tr>
<td>Restriction</td>
<td>Using rules to reduce the opportunity to engage in the target behaviour (or to increase the target behaviour by reducing opportunities to engage in competitive behaviour)</td>
<td>Limit on the number of hours a child can watch TV in the home</td>
</tr>
<tr>
<td>Environmental restructuring</td>
<td>Changing physical or social context</td>
<td>Girls-only physical education classes for girls in high school</td>
</tr>
<tr>
<td>Modelling</td>
<td>Provide an example for people to aspire to increase capability or opportunity</td>
<td>Engaging active peers to promote physical activity to children</td>
</tr>
<tr>
<td>Enablement</td>
<td>Increasing means/reducing barriers to increase capability or opportunity</td>
<td>Prostheses to promote physical activity</td>
</tr>
<tr>
<td>Policies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication / marketing</td>
<td>Using print, electronic, telephone, or broadcast media</td>
<td>Mass-media campaigns (e.g., ParticipACTION's Bring Back Play)</td>
</tr>
<tr>
<td>Guidelines</td>
<td>Creating documents that recommend or mandate practice (including all changes to service provision)</td>
<td>Producing the Canadian Sedentary Behaviour Guidelines for Children and Youth</td>
</tr>
<tr>
<td>Fiscal</td>
<td>Using the tax system to reduce or increase the financial cost</td>
<td>Tax credits to reduce the burden of paying for physical activity programs</td>
</tr>
<tr>
<td>Regulation</td>
<td>Establishing rules or principles of behaviour or practice</td>
<td>Building codes should consider accessibility for those with impairments</td>
</tr>
<tr>
<td>Legislation</td>
<td>Making or changing laws</td>
<td>Municipal bylaws that restrict children playing in the streets</td>
</tr>
</tbody>
</table>

(continued …)
**Table 1 (cont’d)**

**Definitions of Interventions and Policies for Physical Activity and Sedentary Behaviour According to the Behaviour Change Wheel**

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Definition</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental / social planning</td>
<td>Designing and/or controlling the physical or social environment</td>
<td>Planning of urban neighbourhoods to facilitate active transportation</td>
</tr>
<tr>
<td>Service provision</td>
<td>Delivering a service</td>
<td>Recreation service provision in national parks and rural/remote communities</td>
</tr>
</tbody>
</table>


**Selection Criteria of Effective Interventions**

Changing the physical activity and sedentary behaviour patterns at a population level requires programs and interventions that are effective and scalable. Scalability refers to the ability for an intervention to be implemented on a more widespread basis. An intervention is “scaled up” when it is employed among a larger population. Interventions are said to have demonstrated efficacy if they have an impact or achieve an effect in the best of all conditions (e.g., controlled), whereas effectiveness is how well an intervention works in the “real world.”

Research-based criteria for effectiveness place an emphasis on impact (e.g., change in behaviour as a result of the intervention), quality of the study design, cost analyses, and whether the intervention was guided by a theoretical framework. Practice-based criteria place more emphasis on how the intervention/program can be adopted, adapted, and implemented in different settings for various populations. Thus, feasibility within acceptable costs, simplicity, and contexts, including political, social, and economic, are important in this regard. For example, a program that has demonstrated an increase in the physical activity of adults when tested

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39 Flay, “Efficacy and Effectiveness Trials.”

40 Baker and others, “Translating and Disseminating.”

41 Ibid.
in research trials may not be effective when applied in a large workplace setting because it may be costly and require too much time on the part of the employees.

Scaling up an intervention or program involves taking one that has demonstrated efficacy, and hopefully effectiveness, on a small scale and expanding it to reach a greater proportion of the eligible population while retaining effectiveness. Similar to the criteria described for practice-based effectiveness, the scalability of an intervention depends on its demonstrated effectiveness, acceptability and feasibility, potential for reach and adoption, and alignment with the strategic context. Acceptability and feasibility relate to whether the program is seen to be relevant or useful to practitioners/delivery agents and the extent to which it can be implemented given cost and resource demands.

Reach refers to the extent to which people are willing to participate in a program and the representativeness of those participants relative to the target population. Thus, an understanding of the race/ethnicity, gender, age, and socio-economic status of the target population is important. Factors to consider are whether aspects of the intervention or program will appeal to all members of the target population; the costs to participants; and the medium through which participants are recruited or the program is promoted, including traditional media, social media, and referrals. For example, a physician-referred program to promote and monitor walking may not reach young male Canadian adults. Conversely, such a program might have very good reach if the target population was older female adults.

Adoption of a program has to do with the extent to which settings and delivery organizations, including schools, workplaces, and health care institutions, are willing to initiate a program. Similar to reach, the representativeness of the adopting organizations will have an influence

42 Milat and others, “Increasing the Scale and Adoption of Population Health Interventions.”
43 Ibid.
44 www.re-aim.hnfe.vt.edu/about_re-aim/index.html.
45 Ibid.
on how much impact the program can have on the target population. For example, a school-based daily physical activity (DPA) program may not be seen as feasible by most schools if it requires the purchase of new equipment and special training for all teachers. In such a case, the impact or effectiveness of the DPA program would be limited at a provincial or territorial level because few schools would adopt it and, as a result, it would not reach a large proportion of the target population.

The strategic context is important for scalability because it refers to whether a program is consistent with the strategic plans or priorities of the government, organization, or agency through which it is being introduced. In the absence of this synergy with priorities and the subsequent leadership by decision-makers, it is unlikely that an intervention would be scaled up.46

**An Overview of Interventions to Reduce Physical Inactivity and Sedentary Behaviour**

In addition to establishing selection criteria, a high-level review of the research evidence will identify effective interventions in subsequent briefings. Because thousands of studies have been published describing the efficacy or effectiveness of physical activity and, more recently, sedentary behaviour interventions, the most efficient way to summarize the body of evidence on the topic is to turn to meta-analyses and other systematic reviews. Meta-analyses and systematic reviews follow a clear process for identifying and reviewing the literature, and are recognized as excellent sources of summary information. In addition, meta-analyses summarize the quantitative data from each included study and estimate the mean (average) effect (impact) of an intervention across the studies.

For the purpose of the summary on physical activity interventions, this briefing will draw on three sources of information: the Centers for Disease Control and Prevention’s *Guide to Community Preventive*...

46 Milat and others, “Increasing the Scale and Adoption of Population Health Interventions.”
Services,\textsuperscript{47} the meta-analyses included in a review of reviews published in the special Lancet series on physical activity in 2012,\textsuperscript{48} and other meta-analyses published since 2012. This section summarizes the impact of interventions to increase physical activity and then considers the effectiveness and scalability of those interventions relative to the behaviour change wheel and the criteria for effective and scalable interventions previously discussed. The research on sedentary behaviour is in its infancy and thus much more limited. Therefore, the summary will be based on two recent meta-analyses and one other review. The subsequent briefings will apply a more comprehensive search and synthesis of the review evidence.

**Impact of Physical Activity Interventions**

The impact of physical activity interventions ranges from no effect to a large effect.\textsuperscript{49} Much of this variation is due to the different settings (e.g., schools, workplaces, communities, primary care); populations such as children, adults, and chronic disease patients; and types of interventions being examined in the reviews, including computer-based, counselling, behavioural, and pedometer. However, closer inspection reveals that most effects of interventions on physical activity tend to be small to moderate in size. (See Table 2.) Across all interventions with healthy adults, Conn and others reported a difference between the intervention groups and control groups of approximately 500 steps/day or 14.7 minutes more of physical activity over a week.\textsuperscript{50} Though small, this difference is not trivial and would have a significant impact at the level of the population. For example, the Canadian male population would take 10,000 steps per day and move from an average of 27 minutes of MVPA to almost 30 minutes per day. For children and adolescents, the effect

\textsuperscript{47} Centers for Disease Control and Prevention, *Guide to Community Preventive Services*.

\textsuperscript{48} Heath and others, “Evidence-Based Intervention in Physical Activity”; www.thelancet.com/series/physical-activity.

\textsuperscript{49} Ibid.

\textsuperscript{50} Conn, Hafdahl, and Mehr, “Interventions to Increase Physical Activity Among Healthy Adults.”
on accelerometer-determined physical activity is smaller (4 minutes per day), whereas school-based PE interventions appear to have a large impact on MVPA (24 per cent more MVPA during the class). Thus, interventions to address physical inactivity can have an impact on behaviour.

### Table 2

<table>
<thead>
<tr>
<th>Author</th>
<th>Population</th>
<th>Behaviour</th>
<th>Effect size (d)*</th>
<th>Practical outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biddle and others (2011)</td>
<td>Children &amp; adolescents</td>
<td>SB</td>
<td>-0.19</td>
<td>Small effect</td>
</tr>
<tr>
<td>Conn and others (2009)</td>
<td>Adults</td>
<td>PA in the workplace</td>
<td>0.22</td>
<td>612 steps/day</td>
</tr>
<tr>
<td>Conn and others (2011)</td>
<td>Healthy adults</td>
<td>PA</td>
<td>0.19</td>
<td>496 steps/day or 14.7 mins/week</td>
</tr>
<tr>
<td>Hillsdon and others (2012)</td>
<td>Sedentary adults</td>
<td>PA</td>
<td>0.28</td>
<td>Small effect</td>
</tr>
<tr>
<td>Lonsdale and others (2013)</td>
<td>Children &amp; adolescents</td>
<td>MVPA in PE classes</td>
<td>0.62</td>
<td>24% more lesson time in MVPA</td>
</tr>
<tr>
<td>Metcalfe and others (2012)</td>
<td>Children &amp; adolescents</td>
<td>Objectively measured PA</td>
<td>0.12 to 0.16</td>
<td>4 minutes/day</td>
</tr>
<tr>
<td>Prince and others (2014)</td>
<td>Adults</td>
<td>SB</td>
<td>-1.28</td>
<td>Large effect</td>
</tr>
</tbody>
</table>

SB = sedentary behaviour; PA = physical activity; MVPA = moderate to vigorous physical activity

*d = Cohen’s d, which is the standardized mean difference (i.e., the difference between the experimental mean and control group mean, divided by a standard deviation for the data). A general rule of thumb is that d can be categorized as small (0.20 to 0.30), medium (0.50), and large (0.80).

Source: The Conference Board of Canada (created by John Spence).

51 Metcalfe, Henley, and Wilkin, “Effectiveness of Intervention on Physical Activity of Children.”

52 Lonsdale and others, “A Systematic Review and Meta-analysis.”
Effective and Scalable Physical Activity Interventions

To address the question of scalability, the recommendations set by the *Guide to Community Preventive Services* provides insight into some interventions that have been identified in the scientific literature as effective at increasing physical activity based on a series of systematic reviews conducted between 2001 and 2013. The effective interventions are grouped in three general categories: behavioural and social approaches, campaigns and informational approaches, and environmental and policy approaches. (See Table 3.)

Table 3
Effective Interventions to Increase Physical Activity According to the *Guide to Community Preventive Services*

<table>
<thead>
<tr>
<th>Interventions</th>
<th>Effectiveness</th>
<th>Reach and adoption*</th>
<th>Strategic context</th>
<th>Feasibility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Behavioural and social approaches</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individually adapted health behaviour change programs</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Social support interventions in community settings</td>
<td>√</td>
<td>R</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Enhanced school-based physical education</td>
<td>√</td>
<td>R</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td><strong>Campaigns and informational approaches</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community-wide campaigns</td>
<td>√</td>
<td>R</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td><strong>Environmental and policy approaches</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community-scale urban design and land-use policies</td>
<td>√</td>
<td>R</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Creation of, or enhanced access to, places for physical activity combined with informational outreach</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>
### Behavioural and Social Approaches

Among the behavioural and social approaches, three sets of interventions within individually adapted health behaviour change programs, social support interventions, and school-based PE are recommended. On the behaviour change wheel, the individually adapted health behaviour change interventions mostly fall under the intervention functions of education, persuasion, incentivization, training, and enablement. As discussed previously, the most effective behaviour change interventions in this regard include teaching people how to make plans to act upon their intentions or goals, and monitoring their participation in physical activities. A good example of goal setting and self-monitoring—and perhaps one of the more remarkable set of effects to be observed in the literature—is the impact that wearing pedometers has on the number of steps people will take in a day. Reviews of studies involving different populations report an effect equivalent to an increase of 1,950 to 2,500 steps per day.

53 Conn, Hafdahl, and Mehr, “Interventions to Increase Physical Activity Among Healthy Adults”; Michie and others, “Effective Techniques.”

Social support interventions focus on the development and maintenance of social networks that support or encourage physical activity, such as setting up walking groups. On the behaviour change wheel, these fall under the intervention functions of modelling and enablement. School-based PE interventions are good examples of environmental restructuring that may also include education and training. The potential for scaling up behavioural and social approaches will vary by the interventions. (See Table 3.) To the extent that they are resource intensive and can be expensive and require regular interaction with service providers, they may not be adopted and/or feasible. The most scalable interventions would be social support in community settings and enhanced school-based physical education. In the case of the latter, the main issue will be whether schools offer regular physical education taught by specialists.

**Campaigns and Informational Approaches**

Community-wide campaigns were the only set of interventions recommended in the campaigns and informational approaches category. These include interventions that involve many community sectors and complex strategies ranging from social support to risk-factor screening and health education. Examples of such programs are “Shape Up Somerville” in the U.S.\(^{55}\) and EPODE in France, an approach to early childhood obesity prevention.\(^{56}\) These types of interventions could include most of the intervention functions identified in the behaviour change wheel, along with policy initiatives such as communication/marketing, fiscal policy, and service provision. Though community-wide campaigns have demonstrated effectiveness, the primary challenges in scaling them up are adoption and feasibility. These campaigns require considerable coordinated effort across multiple agencies and organizations within communities.

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\(^{55}\) Economos and others, “Shape Up Somerville Two-Year Results.”

\(^{56}\) Borys and others, “EPODE Approach for Childhood Obesity Prevention.”
**Environmental and Policy Approaches**

Environmental and policy approaches include four sets of intervention types, including:

- community-level urban design and land-use policies;
- creation of/enhanced access to locations for physical activity, plus informational outreach;
- street-scale urban design and land-use policies;
- point-of-decision prompts to encourage stairs use.

The first three categories relate to the idea that communities that are walkable will promote walking, cycling, and active play, and are safe from traffic and stranger danger. Though experimental data are not available (i.e., it is impossible to randomly assign people to neighbourhoods), a recent review that controlled for neighbourhood self-selection—i.e., people who want to be physically active will live in, or move to, neighbourhoods that are conducive to activity—found that land-use mix, street connectivity, population density, and overall neighbourhood design are important determinants of physical activity, especially active transportation such as walking to work or school, or for errands.\(^{57}\)

The interventions in the point-of-decision category are classic examples of “nudging”\(^ {58}\) behaviour, such as a sign depicting a healthy heart running up the stairs. In fact, a median change of 2.4 percentage points—a relative increase of 50 per cent from baseline—in the proportion of people taking the stairs as a result of such prompts has been reported across studies.\(^ {59}\) Interestingly, once these types of prompts are removed, the behaviour is not sustained and activities such as stair use will decrease. Thus, such interventions would be more effective as part of a broader community-wide campaign that

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57 McCormack and Shiell, “In Search of Causality.”
58 Thaler and Sunstein, Nudge.
59 Soler and others, “Point-of-Decision Prompts to Increase Stair Use.”
includes sustained prompts. In relation to the behaviour change wheel framework, these interventions focus on environmental restructuring and environmental/social planning.

By their very nature, environmental and policy approaches are perhaps the most scalable of all interventions. The potential limitations are the extent to which they are adopted and implemented by intermediary organizations and agencies, and whether they are consistent with policy priorities. For instance, alterations to community-scale urban design and land-use policies to encourage physical activity may be inconsistent with plans to expand suburban areas and pressures to reduce traffic congestion.

The Potential for Interventions to Reduce Sedentary Behaviour

Our understanding of the factors that influence sedentary behaviour is limited mainly due to the paucity of research on the topic to date. (See “What Motivates Behaviour?”) Of the reviews that have been done, there is a small effect for reducing television and video games consumption among children and adolescents. (See Table 2.) Conversely, interventions to reduce sedentary behaviour in adults have a large effect. These are behaviours that likely have a strong habitual component that are reinforced by environmental cues such as the presence of a TV, or required in certain settings such as sitting in front of a computer in the workplace. But if we ignore what people are doing when they are sitting and focus on the postural component of sitting as the problem, then the solution is much simpler and achievable. That is, the intervention for sedentary behaviour among able-bodied individuals is to reduce sitting and reclining by standing up. As long as people stand up, and/or break up long bouts of sitting, they can still consume

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60 Salmon and others, “Health Risks, Correlates, and Interventions.”
61 Biddle, O’Connell, and Braithwaite, “Sedentary Behaviour Interventions in Young People.”
62 Prince and others, “A Comparison of the Effectiveness of Physical Activity and Sedentary Behaviour Interventions.”
television, watch movies or sporting events, or work—though time spent in front of electronic screens may still be of concern in terms of media exposure such as TV violence and other negative psychological effects, particularly for children and adolescents. This solution requires some education on the part of the public, along with some planning and perhaps environmental restructuring including standing desks or fewer chairs in the room, but it should not be as difficult as addressing the powerful motivational qualities of their favourite sedentary behaviours like watching television. Furthermore, some of the environmental and policy approaches identified for physical activity would also be relevant for sedentary behaviour. For instance, initiatives that increase active transportation can reduce the amount of time that commuters spend sitting in motorized vehicles.

Role of Policy in Addressing Physical Inactivity and Sedentary Behaviour in Canada

As reflected in the behaviour change wheel and the Guide to Community Preventive Services, policy factors will play an important role in addressing physical inactivity and sedentary behaviour at a population level in Canada. Regardless of a person’s motivation and capability, if the environments in which they live, work, and play limit opportunities for physical activity due to rules and regulations, or the lack thereof, then other interventions will be ineffective. In fact, the scalability of interventions depends on the extent to which they align with policy priorities. For example, a campaign to promote active transportation for children will be less than successful if schools do not have procedures supporting safe drop-off zones and bicycle racks.

63 Salmon and others, “Health Risks, Correlates, and Interventions.”
64 Michie, van Stralen and West, “The Behaviour Change Wheel.”
65 Centers for Disease Control and Prevention, Guide to Community Preventive Services.
66 Milat and others, “Increasing the Scale and Adoption of Population Health Interventions.”
An examination of the policy context in Canada in relation to the categories in the behaviour change wheel suggests that we are doing very well in some areas and lacking in others. Areas of strength include communication/marketing, guidelines, and service provision. For example, organizations such as ParticipACTION have achieved high recognition and awareness on the part of the Canadian population through campaigns to promote physical activity.\(^{67}\) Canada is a world leader in developing evidence-based guidelines for physical activity and sedentary behaviour,\(^{68}\) and has also set the standard for grading our efforts in promoting physical activity for children and youth.\(^{69}\) Apart from some communities in the North and other isolated areas, service provision and access to parks and playgrounds is not an issue in this country.\(^{70}\) Though some may argue that Canada is a leader in fiscal policy with the introduction of the Child Fitness Tax Credit in 2007,\(^{71}\) and other similar tax credits in several provinces, most of these tax credit programs are inequitable because they are not accessible to many low-income families,\(^{72}\) and there is no evidence of effectiveness in promoting physical activity.

Policy areas for improvement in this country include environmental/social planning, regulation, and legislation. There is no question that we need more progressive policies at the provincial and municipal levels to promote active transport and active play in and around our communities.\(^{73}\) Apart from a few cities in eastern Canada, the majority of communities were established in the age of the motorized vehicle and do not reflect pedestrian-friendly environments. Thus, bylaws that restrict physical activity—for example, no skateboarding in public

\(^{67}\) Spence and others, “ParticipACTION.”
\(^{68}\) Tremblay and others, “New Canadian Physical Activity Guidelines.”
\(^{69}\) Gray and others, “The 2014 Active Healthy Kids Canada 10th Anniversary Report Card.”
\(^{70}\) Active Healthy Kids Canada, Is Active Play Extinct?
\(^{71}\) www.cra-arc.gc.ca/fitness/.
\(^{72}\) Fisher and others, “Awareness and Use of Canada’s Children’s Fitness Tax Credit”; Spence and others, “Non-Refundable Tax Credits.”
\(^{73}\) Raine and others, “Coming to Consensus.”
places—and encourage sedentary travel should be revisited, and health-impact assessments should be required for planning, development, and transportation policies so they increase walking, cycling, play, and safety for all Canadians. (See “Standards for the Development of Health-Promoting Built Environments.”)

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### Standards for the Development of Health-Promoting Built Environments

The Health Background Study Framework is a tool that helps identify “minimum standards” for built environment factors that developers need to address in their applications.\(^74\) It was developed by Peel Public Health and Toronto Public Health based on the Peel Healthy Development Index. The tool includes targets for six elements of the built environment with demonstrated evidence of association with health:\(^75\)

- **density** (i.e., a minimum overall density target of 200 people and jobs per hectare in urban growth centres);
- **service provision** (i.e., 50 per cent of the projected population shall be no more than 200 metres from a transit stop);
- **land-use mix** (i.e., for communities of 5,000 or more, provide neighbourhood retail and services such as corner stores, elementary schools, and libraries);
- **street connectivity** (e.g., crescent streets, reverse frontage lots and loop roads constituting no more than 20 per cent of total street frontage);
- **streetscape characteristics** (i.e., must have sidewalks on each side of all streets that are 1.5 metres or greater in width in low-density residential areas and at 2 metres or greater in width in higher-density neighbourhoods and mixed-use or commercial areas);
- **parking** (i.e., reductions in parking requirements should be given to buildings and other facilities within 400 metres of a transit stop).

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\(^{74}\) Moloughney and others, “Incorporating Consideration of Health Impacts.”

The Toronto Charter for Physical Activity: A Global Call to Action places considerable emphasis on the role of policy to create sustainable opportunities for physical activity. Specifically, it calls for:

1. the implementation of a national policy and action plan;
2. the introduction of policies that support physical activity such as design guidelines and urban and rural planning;
3. a reorientation of services and funding to prioritize physical activity;
4. the development of partnerships for action.

The charter is an evidence-informed document developed by experts in physical activity and public health and endorsed by a large proportion of researchers and practitioners working in the field. A recent examination of the policy environment in Canada revealed that many provinces had developed, or were in the process of developing, physical activity plans or strategies but that coordination at the national level was fractured and under-resourced. Therefore, leadership and legislation is required at the federal level in Canada to help set a national policy and action plan. This was the impetus that led a group of Canadian physical activity advocates, researchers, and practitioners to consult with more than 1,700 physical activity professionals, including recreation, public health, fitness industry, and sport, to develop Active Canada 20/20: A Physical Activity Strategy and Change Agenda for Canada. The strategy proposes a national plan for action to address physical inactivity and sedentary behaviour. It remains to be seen whether Active Canada 20/20 is endorsed by the federal government and resourced at both the federal and provincial/territorial levels. Nonetheless, along with the Toronto Charter for Physical Activity, it makes a number of useful recommendations for action that can be addressed at municipal or local levels, including a recommendation that policies in the workplace and school setting that encourage active transportation and discourage extended periods of sitting should be a top priority.

76 Global Advocacy Council for Physical Activity, “The Toronto Charter for Physical Activity.”
77 Craig, “Evolution and Devolution.”
78 www.activecanada2020.ca/.
Key Messages

Although most able-bodied Canadians have the capacity to be physically active, the majority are inactive and spend most of their day sitting. This is due to a mismatch between the current environment in which most people live and the physiological and behavioural adaptations that humankind has experienced over a period of 50,000 years. Basically, humans will expend energy to find or obtain food, find a mate, travel, work, take care of children, and for enjoyment. However, if individuals can achieve these objectives in a way that involves expending less energy, then they are likely to choose that option. Furthermore, sitting is a natural behaviour that serves a recuperative/restorative function and often is done while watching television and playing video games—which have very strong attractive and habitual properties—or in environments that restrict movement such as many workplaces and schools.

Thus, interventions to reduce physical inactivity and sedentary behaviour will not be effective over the long term, or at a population level, if they require individuals to make rational choices on a regular basis about their behaviour in environments that do not support those choices. Instead, interventions need to increase the opportunity, capability, and motivation to be physically active and reduce sedentary behaviour. Furthermore, to be useful, such interventions must be practical and cost-effective; have wide appeal for delivery agencies (e.g., public health agencies, workplaces, schools, and health care institutions); and be consistent with strategic targets or objectives of governments and other decision-makers. Therefore, the most effective and scalable interventions to promote healthy active living in Canada involve teaching individuals self-regulatory strategies (e.g., planning, self-monitoring); exposing them to positive physical activity experiences; and creating activity-friendly environments through smart and supportive policies.

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APPENDIX A

Bibliography


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